



U.S. Patent Application Serial No. 10/069,530
Reply to Final OA dated October 19, 2006

For the Examiner's convenience, below is a listing of the claims.

Listing of Claims:

Claim 1 (previously presented): A speech recognition device, comprising:

an input unit that inputs a digital sound signal;

a sound detector that detects the starting point of the digital sound signal in a sound period input by said input unit;

a sound level estimator that estimates the sound level of said sound period based on the digital sound signal in a prescribed time period at the beginning of said sound period input by said input unit in which the sound level estimated (LVL) is based on the equation $LVL = (\sum |DS(x)|)/Q$ where x indicates a Q time point in the rising time for a predetermined sound level, DS(x) indicates the value of a value of the digital sound signal DS at Q time points;

a sound level adjuster that adjusts the level of the digital sound signal in said sound period input by said input unit based on the sound level estimated by said sound level estimator and a preset target level in which the adjusted digital sound signal (CTRL_OUT) is determined by the equations $LVL_CTRL = TGR_LVL/LVL$ and $CTRL_OUT(x) = DS(x) * LVL_CTRL$ in which TRG_LVL is a target value for a predetermined sound level and LVL_CTRL is the adjusted value for the sound level;

a speech recognition unit that performs speech recognition based on the digital sound signal adjusted by said sound level adjuster;

a hold circuit that holds the sound level estimated by said sound level estimator; and

a storing circuit that stores the digital sound signal in said sound period input by said input unit in response to the detection by said sound detector and outputs the stored digital sound signal in said sound period to said sound level adjuster in synchronization with the sound level held in said hold circuit, wherein

said storing circuit includes first and second buffers that alternately store the digital sound signal in said sound period input by the input unit and alternately outputting the stored digital sound signal in said sound period to said sound level adjuster.

Claim 2 (canceled).

Claim 3 (previously presented): The speech recognition device according to claim 1, wherein

said sound level estimator estimates the average value of the digital sound signal in the prescribed time period at the beginning of said sound period input by said input unit as the sound level of said sound period.

Claim 4 (previously presented): The speech recognition device according to claim 1, wherein,

said sound level adjuster amplifies or attenuates the level of the digital sound signal in said sound period input by said input unit by an amplification factor determined by the ratio between said preset target level and the sound level estimated by said sound level estimator.

Claim 5 (previously presented): The speech recognition device according to claim 1, further comprising a delay circuit that delays the digital sound signal input by said input unit so that the digital sound signal in said sound period is applied to said sound level adjuster together and in synchronization with the sound level estimated by the sound level estimator.

Claim 6 (canceled).

Claim 7 (Canceled).

Claim 8 (previously presented): The speech recognition device according to claim 1, wherein

said speech recognition unit has a result of speech recognition fed back to said sound level adjuster, and

said sound level adjuster changes the degree of adjusting said sound level based on the result of speech recognition fed back from said speech recognition unit.

Claim 9 (previously presented): The speech recognition device according to claim 8, wherein said sound level adjuster increases the amplification factor for said sound level when speech recognition by said speech recognition unit is not possible.

Claim 10 (previously presented): The speech recognition device according to claim 1, further comprising a non-linear processor that inactivates said sound level adjuster when the sound level estimated by said sound level estimator is within a predetermined range, activates said sound level adjuster when the sound level estimated by said sound level estimator is not in the predetermined range, and changes the sound level estimated by said sound level estimator to a sound level within the predetermined range for application to said sound level adjuster.

Claim 11 (previously presented): A speech recognition method, comprising the steps of:
inputting a digital sound signal;
detecting the starting point of the digital sound signal in a sound period;
estimating the sound level of said sound period based on the digital sound signal in a prescribed time period at the beginning of said sound period in which the sound level estimated (LVL) is based on the equation $LVL = (\sum |DS(x)|)/Q$ where x indicates a Q time point in the rising

time for a predetermined sound level, DS(x) indicates the value of a value of the digital sound signal DS at Q time points;

holding said estimated sound level;

storing the digital sound signal in said sound period in response to the detection of the starting point of said digital sound signal and outputting said stored digital sound signal in said sound period in synchronization with said held sound level;

adjusting the level of said output digital sound signal in said sound period based on said held sound level and a preset target level in which the adjusted digital sound signal (CTRL_OUT) is determined by the equations $LVL_CTRL = TGR_LVL/LVL$ and $CTRL_OUT(x) = DS(x) * LVL_CTRL$ in which TRG_LVL is a target value for a predetermined sound level and LVL_CTRL is the adjusted value for the sound level; and

performing speech recognition based on said adjusted digital sound signal, wherein

said step of storing includes the step of storing the digital sound signal in said sound period alternately to first and second buffers and outputting the stored digital sound signal in said sound period alternately from the first and second buffers.

Claim 12 (canceled).

Claim 13 (previously presented): The speech recognition method according to claim 11,
wherein

said step of estimating the sound level includes estimating the average value of the digital sound signal in the prescribed time period at the beginning of said sound period as the sound level of said sound period.

Claim 14 (previously presented): The speech recognition method according to claim 11,
wherein

said step of adjusting the level of said digital sound signal includes amplifying or attenuating the level of the digital sound signal in said sound period by an amplification factor determined by the ratio between said preset target level and said held sound level.

Claim 15 (previously presented): The speech recognition method according to claim 11,
further comprising the step of delaying the digital sound signal so that said digital sound signal in said sound period is applied together and in synchronization with said held sound level to the step of adjusting said output level of said digital sound signal.

Claim 16 (Canceled).

Claim 17 (Canceled).

Claim 18 (Original): The speech recognition method according to claim 11, wherein
said step of performing speech recognition includes the step of feeding back a result of
speech recognition during said step of adjusting the level of the digital sound signal, and
said step of adjusting the level of the digital sound signal comprises changing the degree of
adjusting said sound level based on said fed back result of speech recognition.

Claim 19 (Original): The speech recognition method according to claim 18, wherein
said step of adjusting the level of the digital sound signal comprises increasing the
amplification factor for said sound level when said speech recognition is not possible.

Claim 20 (Original): The speech recognition method according to claim 11, further
comprising the step of inactivating the step of adjusting the level of the digital sound signal when
said estimated sound level is within a predetermined range, while activating said adjusting step when
said estimated sound level is not in the predetermined range, and changing said estimated sound
level to a sound level within said predetermined range for use in adjusting the level of said digital
sound signal.

Claim 21 (previously presented): A computer program embodied in a computer-readable
medium and executable by a computer for speech recognition, comprising the steps of:

inputting a digital sound signal;

detecting the starting point of the digital sound signal in a sound period;

estimating the sound level of said sound period based on the digital sound signal in a prescribed time period at the beginning of said sound period in which the sound level estimated (LVL) is based on the equation $LVL = (\sum |DS(x)|)/Q$ where x indicates a Q time point in the rising time for a predetermined sound level, DS(x) indicates the value of a value of the digital sound signal DS at Q time points;

holding said estimated sound level;

storing the digital sound signal in said sound period in response to the detection of the starting point of said digital sound signal and outputting said stored digital sound signal in said sound period in synchronization with said held sound level;

adjusting the level of said output digital sound signal in said sound period based on said held sound level and a preset target level in which the adjusted digital sound signal (CTRL_OUT) is determined by the equations $LVL_CTRL = TGR_LVL/LVL$ and $CTRL_OUT(x) = DS(x) * LVL_CTRL$ in which TRG_LVL is a target value for a predetermined sound level and LVL_CTRL is the adjusted value for the sound level; and

performing speech recognition based on said adjusted digital sound signal, wherein

said step of storing includes the step of storing the digital sound signal in said sound period alternately to first and second buffers and outputting the stored digital sound signal in said sound period alternately from the first and second buffers.